REMARKS

Claims 9-27 and 35-50 were pending. By the above amendment, the applicants have canceled claims 24 and 50 and amended claim 11, 25 and 37. The applicants request further consideration and re-examination in view of the amendments above and remarks below.

Rejections under 35 U.S.C. § 112:

Claims 9, 25 and 35 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Specifically, the office states that it is unclear what is meant by the limitation "the first and second quorums each meeting a quorum condition of a number such that any two selections of the number of the stripe blocks intersect in a minimum number of the stripe blocks needed to decode the stripe."

The applicants respectfully traverse the rejection. According to the Manual of Patent Examining Procedure (MPEP), the essential inquiry is "whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity." Definiteness of claim language must be analyzed, not in a vacuum, but in light of: the content of the particular application disclosure; the teachings of the prior art; and the claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made. MPEP at Section 2173.02 (Aug. 2006).

The applicants' submit that the limitation is sufficiently clear, particularly when read (as it must be) in light the applicants' disclosure. The applicants' specification clearly explains that data is stored across n of the storage devices as a stripe of erasure coded data comprising n stripe blocks. The n stripe blocks may comprise m data blocks plus p parity blocks ($n = m + p$). The p parity blocks may comprise 2f parity blocks, where f is a number of the n stripe blocks that are tolerated as faulty ($n = m + p = m + 2f$). A quorum is defined as a number of the n stripe blocks that meets a quorum condition. The applicants define their quorum condition such that any selection of two sets of the n stripe blocks intersect in m of the n stripe blocks. Therefore, if the n stripe blocks are encoded as the m data blocks plus the p parity blocks and p is an even number, the quorum is $m + p/2$. In this situation, the quorum is also $m + f$. If the n stripe blocks are encoded as the m data blocks plus the p parity blocks and p is an odd number, the quorum is $m + p/2 + 1/2$. Applicants' specification at page 4, line 22 to page 5, line 2.

It is clear from this detailed explanation contained in the applicants' specification that that applicants have defined the quorum condition to be a number that is greater than m (the number of data blocks in the stripe, excluding parity blocks) and less than n (the total number of blocks in the stripe including data blocks and parity blocks). Specifically, the quorum condition is defined in the specification and in claims 9, 25 and 35 to be a number such that any two selections of the number of the stripe blocks intersect in a minimum number of the stripe blocks needed to decode the stripe. Accordingly, the write transaction of claims 9, 25 and 35 requires a minimum number of participants to reply to the queries specified in the claims. However, the write transaction can still be performed even if a reply is not received from every storage device for the stripe.

In view of the above, the applicants request that the rejection of claims 9, 25 and 35 under 35 U.S.C. 112 be removed.

Claims 24 and 50 were also rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Specifically, the office action states that it is unclear "how the method of writing data comprising receiving a data block for storage within a stripe of erasure coded data (as claimed in claim 9) when the erasure coded data was not previously stored using a striping technique (as claimed in claim 24)."

The applicants have canceled claims 24 and 50.

Rejections under 35 U.S.C. § 102:

Claims 9-23, 25-27 and 35-49 were rejected as being unpatentable over U.S. Patent No. 5,740,465 to Matsunami et al (hereinafter "Matsunami").

Regarding claim 9, the office action states that:

> Matsunami discloses a method of writing data comprising the steps of receiving a data block for storage within a stripe of erasure coded data (receiving a host command from the host computer), the stripe comprising stripe blocks (data is divided into a plurality of data units called stripes, Col. 1, lines 43-44); sending a query message to each of a plurality of storage devices upon which the stripe of erasure coded data is stored (queuing the command in a command queuing means which stores and manages the commands); receiving a query reply message from each of at least a first quorum of the storage devices (command start message); sending a modify message to each of the storage devices (interpreting the host command and generating a disk command); and receiving a write reply message from each of at least a second quorum of the storage devices (command end message, see

> Col. 10, lines 45-67). In this system the stripes are stripes of erasure-coded data since the data is subject to parity code protection, which is a form of erasure coding.

The applicants respectfully traverse the rejection. In order to properly reject a claim under 35 U.S.C. § 102, each and every element as set forth in the claim must be identically found in the prior art in as complete detail as is contained in the claim. See Manual of Patent Examining Procedure at Section 2131 (Aug. 2006)(citations omitted). The applicants respectfully submit that several limitations of applicants' claim 9 are not disclosed in the Matsunami reference.

The Matsunami reference is directed toward a disk array controller "for realizing a high-speed data transfer in an array disk system with a plurality of disk units connected." Matsunami at col. 1, line 6-8. Matsunami explains that prior disk arrays systems suffer from a number of drawbacks including reduced processing speed when processing accesses made to continuous areas in a disk array system. Matsunami at col. 1, line 64, to col. 4, line 42.

Matsunami proposes a solution to these problems. Matsunami at col. 5, lines 1-2. Particularly, the invention of Matsunami is disk array controller that receives host commands from a host computer and that converts the host commands into disk commands that are issued to each disk unit. Matsunami at col. 5, lines 2-7. The disk array controller also temporarily stores commands continuously issued by the host in a queue. Matsunami at col. 5, lines 12-14. A plurality of commands stored in the queue are grouped and regarded as one command and converted into a disk command to be applied to each disk unit. Matsunami at col. 5, lines 15-21. For writing data, a plurality of commands are grouped, data is read for parity generation, and after parity generation, a write operation is performed. Matsunami at col. 5, lines 53-60. According to Matsunami, because a plurality of sequential access commands are converted into a single sequential access command, the data is handled continuously and collectively, and disk rotational latency is eliminated, thereby realizing a high-speed data transfer. Matsunami at col. 5, lines 46-52.

Among its limitations, applicants' claim 9 recites "sending a query message to each of a plurality of storage devices upon which the stripe of erasure coded data is stored" and "receiving a query reply message from each of at least a first quorum of the storage devices." The office action alleges that Matsunami discloses the claimed step of sending the query message by disclosing "queuing the command in a

command queuing means which stores and manages the commands." The office action further alleges that Matsunami discloses the claimed step of receiving the query reply by disclosing a "command start message." The applicants strongly disagree. First, queuing commands in the controller does not disclose "sending a query message." This is at least because queuing is not equivalent to sending. Second, the applicants are unable to locate the alleged teaching of a "command start message" anywhere in Matsunami. In fact, the office action does not specify any location in Matsunami for this alleged teaching in Matsunami of a "command start message" and a computerized word search of the text of Matsunami does not locate any instances of the term "command start message." Third, Matsunami does not disclose the use of any quorum of replies as is required by applicants' claim 9.

In addition to the above limitations, applicants' claim 9 also recites "sending a modify message to each of the storage devices" and "receiving a write reply message from each of at least a second quorum of the storage devices." The office action alleges that Matsunami discloses the claimed step of sending the modify message by disclosing "interpreting the host command and generating a disk command." The office action further alleges that Matsunami discloses the claimed step of receiving the write reply by disclosing a "command end message" at col. 10, lines 45-67 of Matsunami. The applicants strongly disagree. Taken together with the limitations of claim 9 mentioned previously, these additional limitations mean that writing the data requires two rounds of messages to the storage devices and two rounds of replies. Particularly, a query message is sent to the storage devices and a query reply is received. Then, a modify message is sent to the storage devices and a write reply is received. At best, Matsunami discloses issuing a generated disk command to each disk unit and receiving a command end from each disk unit (see Matsunami at col. 10, lines 58-59). This teaching, however, does not anticipate two rounds of messages and replies, as are recited by applicants' claim 9.

Further, like the first round of messaging and reply of claim 9, the second round of messaging and reply also requires that a reply is received from each of at least a second quorum of the storage devices. As explained above, Matsunami does not disclose the use of any quorum of replies. Therefore, Matsunami cannot disclose two such quorums of replies.

Finally, claim 9 requires that the first and second quorums each meet a quorum condition of a number such that any two selections of the number of the stripe

blocks intersect in a minimum number of the stripe blocks needed to decode the stripe. Because Matsunami does disclose the use of any quorum of replies, Matsunami cannot disclose the particular quorum condition for the first and second quorums of replies which is recited by applicants' claim 9.

In view of the above, applicants' claim 9 recites several limitations which are not disclosed by Matsunami. However, in order to anticipate claim 9, Matsunami would have to identically teach every limitation of claim 9. Accordingly, claim 9 is allowable over Matsunami. Claims 10-23 are allowable at least because each depends from an allowable base claim 9.

Moreover, dependent claims 10-23 recite limitations that are not disclosed by Matsunami. For example, dependent claim 11 is amended to clarify that the query message includes an identifier of the stripe of erasure coded data. This feature is disclosed in the applicants' specification at least at page 7, lines 22-27. The office action asserts that Matsunami discloses an indicator of whether a command is a read or a write command. The applicants submit that such an indicator of Matsunami does not disclose the identifier of applicants' amended claim 11. This is another reason why claim 11 is allowable.

As another example, dependent claim 12 recites that the query messages include a timestamp indicating a current time. The office action asserts that because Matsunami teaches a data transfer timing controller for giving an instruction on an appropriate transfer timing to the data controller, "a timestamp must be provided with the command in order to properly perform this operation." The applicants strongly disagree with this reasoning. First, the instruction referenced in the office action is clearly an instruction from the command controller 6 to the data controller 5 of Matsunami. The command controller 6 and data controller 5 of Matsunami are located within the disk array controller 3, whereas the disks are located outside the controller 3. See Figure 1 of Matsunami. Therefore, instruction referenced in the office action cannot be equivalent the "query messages" recited in claim 12 at least because the "query messages" are sent to storage devices. Second, there is no teaching in Matsunami that the command of Matsunami includes a timestamp. Rather, the office action is merely speculating about how the system of Matsunami might operate. However, speculation cannot form the basis of a rejection under 35 U.S.C. § 102. See Manual of Patent Examining Procedure at Section 2112 (Aug. 2006)(explaining that to establish inherency, it must be clear that the missing

descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill; inherency, may not be established by probabilities or possibilities). This is another reason why claim 12 is allowable.

Dependent claims 13-22 are dependent from claim 12 and recite further limitations regarding the timestamp and also recite a pending write timestamp and a validation timestamp. As explained above, there is no teaching in Matsunami regarding a timestamp sent in query messages to storage devices, as in applicants' claim 12. For at least this reason, claims 13-22 are allowable. Moreover, the office action asserts that Matsunami teaches the pending write timestamp and the validation timestamp by further speculation as to how the system of Matsunami might operate. As explained above, speculation cannot form the basis of a rejection under 35 U.S.C. § 102. This is another reason why claims 13-22 are allowable.

Regarding independent claim 25, the office action states that:

> Claim 25 is rejected using the same rationale as that of Claim 9 wherein the stripe blocks comprise a first number of data blocks and a second number of parity blocks (data is divided into a plurality of data units called stripes, and a group called a parity group is formed of all the stripes..., Col. 1, lines 43-46); the query messages sent to a target storage device include a timestamp indicating a current time. Since the system includes a data transfer controller for giving an instruction appropriate transfer timing to the data controller (Col. 10, lines 45-67), a timestamp must be provided with the command in order to properly perform this operation; and wherein the reply messages of the first quorum each indicate that the timestamp is later than a pending write timestamp and later than a validation timestamp of a previous version of the data block. Since the reply message indicates a command start message, the timing of the data transfer controller must indicate that the current time is later than a pending write timestamp (which means that the write can be performed because the previous write has finished) and later than a validation timestamp (which means that the previous version of the data block is no longer valid and therefore, can be modified). See Col. 10, lines 45-67. The query reply message in the form of a command start message includes the validation timestamp and the previous version of the particular data block since these are stored in the block of data the will be written to by the command and the command start message points the system to such a location. In receiving a command end message, the system is essentially stating that the timestamp equals the maximum timestamp and therefore, the command has ended.

The applicants respectfully traverse the rejection. Similarly to claim 9, claim 25 recites sending a "query message" to each of a plurality of storage devices upon which the stripe of erasure coded data is stored, "receiving a query reply message from each of at least a first quorum of the storage devices," "sending a modify message to each of the storage devices" and "receiving a write reply message from each of at least a second quorum of the storage devices."

As explained above, Matsunami does not disclose all of these limitations. First, queuing commands in the controller of Matsunami does not disclose "sending a query message." This is at least because queuing is not equivalent to sending. Second, the applicants are unable to locate the alleged teaching of a "command start message" in Matsunami. Third, Matsunami does not disclose the use of any quorum of replies. For at least these reasons, claim 25 is allowable.

Further, as is the case with claim 9, claim 25 requires that writing the data includes two rounds of messages to the storage devices and two rounds of replies. Particularly, a query message is sent to the storage devices and a query reply is received. Then, a modify message is sent to the storage devices and a write reply is received. At best, Matsunami discloses (at col. 10, lines 58-59) issuing a generated disk command to each disk unit and receiving a command end from each disk unit. However, Matsunami does not disclose two rounds of messages and replies, as are recited by applicants' claim 25. This is another reason why claim 25 is allowable.

In addition, claim 25 requires that the first and second quorums each meet a quorum condition of a number such that any two selections of the number of the stripe blocks intersect in a minimum number of the stripe blocks needed to decode the stripe. Because Matsunami does disclose the use of any quorum of replies, Matsunami cannot disclose the particular quorum condition for the first and second quorums of replies which is recited by applicants' claim 25. This is yet another reason why claim 25 is allowable.

Also, claim 25 recites that the query message includes a timestamp indicating a current time and is send to the storage devices. However, the instruction referenced in the office action is clearly an instruction from the command controller 6 to the data controller 5 of Matsunami. The command controller 6 and data controller 5 of Matsunami are located within the disk array controller 3, whereas the disks are located outside the controller 3. See Figure 1 of Matsunami. Therefore, the

instruction referenced in the office action cannot be equivalent the "query messages" recited in claim 25 at least because the "query messages" are sent to storage devices. Also, there is no teaching in Matsunami that the command of Matsunami includes a timestamp. However, the assertion that Matsunami discloses such a timestamp is based on mere speculation of how the system of Matsunami might operate. These are still more reasons why claim 25 is allowable.

Finally, claim 25 also a validation timestamp and a pending write timestamp. In contrast, Matsunami does not disclose any timestamps. The office action asserts that Matsunami teaches the pending write timestamp and the validation timestamp by speculating as to how the system of Matsunami might operate. As explained above, speculation cannot form the basis of a rejection under 35 U.S.C. § 102. This is another reason why claim 25 is allowable.

In view of the above, applicants' claim 25 recites several limitations which are not disclosed by Matsunami. Accordingly, claim 25 is allowable over Matsunami. Claims 26 and 27 are allowable at least because each depends from an allowable base claim 25.

Claim 35 recites a computer readable memory comprising computer code for implementing a method of writing data in which the method of writing the data comprises the steps recited in claim 9. Therefore, applicants' claim 35 is allowable for at least the same reasons that claim 9 is allowable. Claims 36-49 are allowable at least because each depends from an allowable base claim 35. Moreover, as explained above with reference to dependent claims 10-22, dependent claims 36-49 recite limitations that are not disclosed by Matsunami.

Conclusion:

In view of the above, the Applicants submit that all of the pending claims are now allowable. Allowance at an early date would be greatly appreciated. Should any outstanding issues remain, the Examiner is encouraged to contact the undersigned at (408) 293-9000 so that any such issues can be expeditiously resolved.

Respectfully Submitted,

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